

Wastewater Additional Treatment Cost Rate Study

City of Memphis Public Works
Memphis, Tennessee



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EXECUTIVE SUMMARY

Memphis City Code establishes the requirements for setting sewer fees and charges to recover costs associated with additional treatment requirements for wastewater that exceeds normal residential strength sewerage in Biological Oxygen Demand (BOD) and Total Suspended Solids (TSS). Defined in the Memphis City Code is the formula for calculating the Additional Treatment Cost (ATC) and guidelines for setting the parameters of the equation. Since these parameters were last established in 1982, the City of Memphis has commissioned a review of the parameters to determine the adjustments needed to properly recover costs associated with the treatment and disposal of higher strength wastewater. Utilizing the guidelines of Chapter 33 Memphis Code, operational characteristics of the Stiles (North) and Maxson (South) Treatment Plants have been reviewed along with the expenses and debt service associated with treatment of BOD and TSS to determine new parameters for the ATC formula. When these results are applied to the equation, the BOD portion equates to be an additional treatment cost of \$0.0428 per pound of BOD above 250 milligrams per liter (mg/l). For Suspended Solids, the additional treatment cost equates to \$0.0716 per pound above 300 ppm. These costs represent a 12.9% increase in BOD charges and a 8.3% increase in Suspended Solids charges.

BACKGROUND

Chapter 33 of the Memphis City Code establishes the requirements for sewers and sewage disposal. In Division 2 of the code, the methods for establishing sewer fees and charges are defined including provisions for assessing Additional Treatment Cost (ATC) for discharged wastewater that exceeds Biological Oxygen Demand (BOD) and Total Suspended Solids (TSS) of typical residential sewerage. In 1982, the City of Memphis set the parameters for calculating the ATC to be assessed. Due to higher treatment costs and standards, the City of Memphis has chosen to evaluate the associated costs for treatment and disposal of the higher strength wastewater and to make recommendations for modifications of the charges assessed by the ATC.

APPROACH

The Memphis City Code is very specific in defining the parameters of how the ATC is assessed. In the code, the following formula is defined:

$$ATC = [U(B) \times T(B)/B] + [U(S) \times T(S)/S]$$

Where:

U(B) = BOD loading in excess of 250 milligrams per liter

T(B) = Treatment costs assigned to BOD (including debt service, operation, maintenance, and replacement costs).

B = Total BOD loading or BOD capacity of treatment plants, whichever is less.

U(S) = TSS loading in excess of 300 milligrams per liter.

T(S) = Treatment costs assigned to TSS (including debt service, operation, maintenance, and replacement costs).

S = Total TSS loading or TSS capacity of treatment plants, whichever is less.

The code also defines the periods for evaluating each of these parameters. In Section 33-133, Sewer Fee Review, costs used in the formula shall be based on a five-year average. These costs will be used to determine the projected costs for ATC for Fiscal Year 2011 which will be used as the baseline year for the recommended parameters.

PARAMETER CALCULATIONS

Parameters U(B), B, U(S), and S can be determined by reviewing operational history of the Maxson (South) Treatment Plant and Stiles (North) Treatment Plant. Data furnished by the City of Memphis was reviewed to determine influent wastewater characteristics. The average daily BOD loading during the 5 year review period was 678,489 pounds for both wastewater treatment plants. Using this information, U(B) was calculated as follows:

Calculating U(B) for BOD

Average Daily Loading Both Plants (lbs)	678,489
Less Daily Loading for 250 mg/l	
5-Year Average Daily Dry Weather Flow (MGD)	140.6
x baseline loading (mg/l)	250
x unit weight (lbs/gallon)	<u>8.34</u>
Subtotal	293,193
Excess Daily Loading (lbs)	385,296
x days/year	<u>x 365</u>
Annual Excess BOD Loading (lbs)	U(B) = 140,633,004

Also using the same BOD information, parameter B can be determined by the following:

Calculating B for BOD

Average Daily Loading (lbs)	678,489
x days/year	<u>x 365</u>
Total Annual BOD Loading	B = 247,648,339

In reviewing information for Total Suspended Solids (TSS), it was determined that special adjustments would be required for analyzing the South Plant TSS due to the recycling that occurs during higher loading periods. Based on information available, Table 1 below summarizes the adjustments made for the five-year analysis period of 2005 through 2009.

Table 1

Total Suspended Solids Adjustment – Maxson (South) Treatment Plant City of Memphis Public Works 2010						
	<u>2005</u>	<u>2006</u>	<u>2007</u>	<u>2008</u>	<u>2009</u>	<u>5-year Avg.</u>
Daily Avg. (lbs)	405,365	491,425	349,465	391,264	308,366	389,177
Daily Recycled Avg. (lbs)	(110,583)	(197,972)	(73,330)	(85,740)	(50,481)	(103,621)
Estimated Recycled TSS Treated (lbs)	20,000	20,000	20,000	20,000	20,000	-
Total Adjusted Daily Average (lbs)	314,782	313,453	296,135	325,524	277,886	305,556

Utilizing the above adjusted loadings, the South Plant average daily influent loading is 305,556 pounds. This, combined with the North Plant average loading of 244,420 pounds per day, provides an adjusted total plant TSS loading of 549,976 pounds per day. This loading can be used in calculating U(S) as follows:

Calculating for U(S) for TSS

Average Daily Loading (lbs)	549,976
Less Daily Loading for 300 mg/l:	
5-Year Average Daily Dry Weather Flow (MGD)	140.6
x baseline loading (mg/l)	300
x unit weight (lbs/gallon)	<u>8.34</u>
Subtotal	351,831
Excess Daily Loading (lbs)	198,145
x days/year	<u>x 365</u>
Annual Excess TSS Loading (lbs) U(S) = 72,322,754	

Also using the same TSS information, parameter S can be determined by the following:

Calculating S for TSS

Average Daily Loading (lbs)	549,976
x days/year	x <u>365</u>
Total Annual TSS Loading	S = 200,741,156

In analyzing the cost parameters T(B) and T(S), several considerations have to be made. Historical operation and maintenance expenses must be reviewed to determine the appropriate allocation of expenses to BOD treatment, TSS handling, and overall general flow of the treatment plants. In addition to operation and maintenance expenses, debt service must be separated between the collection system and the treatment system. Then, the treatment system debt service must be allocated across the same categories of BOD, TSS, and flow. Once all allocations have been determined, the total costs incurred for BOD and TSS can be summed from the operating and maintenance expenses and the appropriate debt service.

Operational and maintenance expenses were obtained from actual Appropriation Statements from Fiscal Years 2006 through 2010 (estimated). These expenses were analyzed to determine a rate of growth in order to project anticipated expenses for Fiscal Year 2011 to be used as our baseline for determining the cost parameters. In reviewing these historical expenses, 4.38% annual rate of growth was determined. This rate of growth was then applied to Fiscal Year 2010 results to obtain the estimated Fiscal Year 2011 expenses. The summary of these expenses by plant are shown below.

Operating & Maintenance Expenses

Fiscal Year	Maxson	Stiles	Total
2006	\$10,885,285	\$9,917,145	\$20,802,430
2007	\$11,089,232	\$10,195,653	\$21,284,885
2008	\$12,050,218	\$10,114,816	\$22,165,034
2009	\$12,519,565	\$11,967,823	\$24,487,388
2010 (estimated)	\$12,548,379	\$11,295,456	\$23,834,835
Average % increase per year =			4.38%
2011 projected			\$24,887,380

The operating and maintenance expenses must be allocated to BOD, TSS, and flow as discussed previously. To accomplish this, we received input from the City's Superintendent of Wastewater Treatment and reviewed the operational characteristics of the plants. The allocation was determined to be 26.1%, 65.1%, and 8.7% for BOD, TSS, and flow respectively.

For the debt service portion of the parameter costs, debt service for the period from 1991 to 2012 was reviewed to determine the amount that would be attributable to wastewater treatment. A review of records indicate that during this period 41.1% of the debt service can be attributed to wastewater treatment with the remaining 58.9% being appropriated to the wastewater collection system. In reviewing 43 capital improvement projects associated with wastewater treatment, the following cost allocations were determined:

Flow	=	8.7%
BOD	=	26.1%
TSS	=	65.1%

With an anticipated total debt service of \$15,759,000, the associated debt service for BOD and TSS would be as follows:

	<u>BOD</u>	<u>TSS</u>
Anticipated FY2011 Debt Service	\$15,759,000	\$15,759,000
Treatment Facility Allocation	41.06%	41.06%
BOD/TSS Process Allocation	26.1%	65.14%
FY2011 Debt Service Allocation	\$1,688,621	\$4,214,920

Using the estimated total operating and maintenance expenses for FY2011, allocation factors, and the appropriate debt service, the final parameters of T(B) and T(S) can now be calculated.

FY2011 BOD & TSS Projected Costs, Both WWTP's

Operating & Maintenance Expenses	<u>BOD</u>	<u>TSS</u>
Est. O&M	\$24,887,380	\$24,887,380
Allocation %	<u>35.8%</u>	<u>40.8%</u>
Allocation	\$8,909,628	\$10,154,051
Debt Service	<u>\$1,688,621</u>	<u>\$4,214,920</u>
Total FY2011 Projected Cost	T(B) = \$10,598,303	T(S) = \$14,368,971

CONCLUSION

Based on the operational data and financial information provided by the City of Memphis, the current ATC charges for BOD/Suspended Solids need to be updated. In accordance with Chapter 33 of the Memphis City Code, the following parameters required for the ATC equation defined in Division 2, Section 33-131.b.2 are recommended to be as follows:

$$U(B) = 140,633,004$$

$$T(B) = \$10,598,303$$

$$B = 247,648,339$$

$$U(S) = 73,322,754$$

$$T(S) = \$14,368,971$$

$$S = 200,741,157$$

When these results are applied to the equation, the BOD portion equated to be an Additional Treatment Cost (ATC) of \$0.0428 per pound of BOD above 250 ppm (Parts per million). For Suspended Solids, the additional treatment cost equates to \$0.0716 per pound above 300 ppm. These costs represent a 12.9% increase in BOD charges and a 8.3% increase in Suspended Solids charges.